

Geospatial technology for defence and border security

Bentley's geospatial server-based technology can provide contextually intelligent and immediate access to all information critical to defence organisations

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AMONG THE MANY GROUPS finding effective ways to apply geospatial technology today are national defence strategists, who use it to support tactical decision making. As applied by these crucial organisations, the technology must consistently ensure streamlined information flows and support multidirectional strategies.

One of the vital responsibilities placed in the hands of national defence organisations is border surveillance. This entails recording and playing back incidents that occur every day, every hour, and every minute at the country's border posts. A geospatial information system capable of automatically recording and creating an audit trail of this type of information would be much more efficient and could lead to enhanced decision making.

Until a few years ago, most geospatial information systems were designed around a single-mission objective. Each of the physically isolated systems maintained its own data stores and applications, and all data resided in silos. Efforts at integration often resulted in



replicated, unsynchronised data existing among various systems. Moreover, data security generally was poorly enforced, with a single level of authorisation being all that was required for a user to enter the system and access all of its data and applications. Such an approach is not only unsafe,

but also expensive and inefficient. Moreover, it doesn't provide flexibility in enforcing multiple levels of access controls and the degree of security that defence organisations and others typically require.

Geospatial information systems deployed for defence purposes

should have the flexibility to integrate with other systems and facilitate collaborative workflows. This is important since multiple systems are built for specific purposes and establishing streamlined collaborative workflows among them is necessary to give the defence strategist an appropriate view of the situation, enabling the right decisions to be made more quickly.

This system facilitates not only collaboration and data integrity but also intuitive spatial searches and navigation of information, audit trails, effective digital rights and workflow management, and intelligent plotting.

Making information geospatially aware

Making information geospatially aware is all about associating a spatial location with a document or folder. This association makes all of the information available through a background map that is geo-coordinated. The background map is displayed and used to navigate all content within the geospatially managed environment. The software technology provides tools that help associate content to a location and uses folder properties to associate child documents to the same location, minimising manual entry of spatial locations and other metadata. It also makes it possible to extract geospatial location from geospatially aware documents such as imagery, empowering users to find documents by performing spatial queries and illustrate their position on a map. This provides a visual way of searching as opposed to the traditional file-name based search.

Spatial navigation and query

Finding the right information in support of the decision-making process is, of course, of critical importance. While there are a variety of tools available for this purpose, one of the most intuitive is spatial navigation. We all read maps and relate "things" to "places." Geospatially aware technology delivers this key capability in a way that is practical, easy to implement, and delivers immediate results.

The geospatial server allows users to register spatial locations, and then locate documents or sets of documents through intuitive queries. Any mix of spatial and non-spatial attributes can constrain a query and be used in combination with spatial navigation. Map-based navigation is also available to aid in identifying a location of interest, effectively narrowing search criteria.

Find rather than search for information

Finding information is always far easier and less time consuming than searching for it. For example, the Google technology is able to "find" information quickly because all of it has been indexed. Similarly, Bentley Geospatial Server provides tools to spatially index features, databases, files, and documents. Users can display, search, and review the properties of features from a spatial interface, and individual features can be found and depicted visually on the background map. Moreover, the properties of the features can be reviewed and indexed features can be accessed from a "list view."

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Location is automatically deduced for files or documents with inherent coordinate systems, including DGN, GeoTIFF, SHP, and more. Documents that are non-spatial can inherit the location from the folder into which they are inserted. Alternatively, an administrator can use a map-based interface to define a location for a document or folder of documents, as well as import CAD-based cartographic indexes. Non-spatial information can be quickly geocoded using an attribute. The document will acquire the spatial location of a boundary when an associated attribute is set for the document.

The power of this spatially-enabled managed environment extends beyond the location of documents and other information. At the time of display, maps and drawings can be re-projected and accurately superimposed upon each other automatically. Adding connections to geocoding servers (such as the one offered by MapQuest) to resolve geocoding issues can also improve search queries. Once the geocoding issues are resolved,

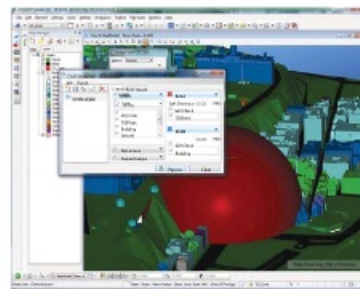


Figure 1: Spatial analysis of the impacts an explosion would have on infrastructure

the spatial criteria can be used in a query to display a map.

Another useful feature of a spatially-enabled managed environment includes linear referencing documents, folders and projects (for example, "Find all the critical bridge projects along the border road.") The association of information using a linear reference can be executed manually as well as semi-automatically. Users can also do a linear search by specifying linear criteria in a standard search that can be combined with other criteria, including spatial extent.

Manage change in the information

All information, especially in the context of defence, is subject to frequent changes and updates. This is the case for both non-spatial and spatial information. Therefore, it is important to determine who can add or change information, and under what circumstances. Knowing who has access to what and when is critically important. The server provides system and content access controls so desired workflows can be implemented surely and reliably.

To maintain information integrity, exposing the detailed history reveals who did what and when, providing a comprehensive audit trail of a project. It can also support returning to a given stage of work, quickly displaying differences in map features graphically, and selectively undoing changes. Historical maps and reports needed to support studies and planning or meet government regulations can be produced by leveraging historical data management

capabilities. This would support projects in which deleted features are not deleted from the database until they are retired. Updated features aren't simply updated, but rather a copy of the old feature is preserved and the updated feature is created.

It is also possible to make edits in the present and have them reflected only in the future using temporal data management. This avoids the need to edit the database at a specific time for time-critical updates to the database.

Streamlined workflow through effective collaboration

Defence organisations can easily manage complex workflows from creation to approval. States, user roles, and valid workflows can be defined with ordered milestones through which an object makes its way to completion. A focus on the whole enterprise can bring together the management of information captured in the field or throughout the enterprise. The managed environment can also log all actions and changes made to documents and files, and can store and manage multiple versions of them. This enables design comparisons between versions of digital plots, records document and folder activity in audit trails, and ensures users always have access to the latest version.

Securing intellectual data or information

Any information in a given national defence organisation, whether it is geospatial information, engineering content, or other attribute information, is an asset and, therefore, its integrity is crucial.

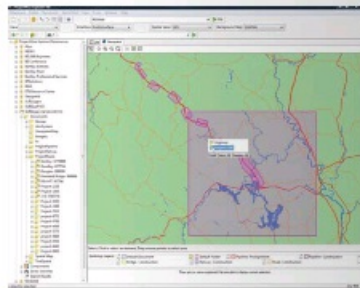


Figure 2: Data and documentation can be navigated through a map interface or through a folder tree

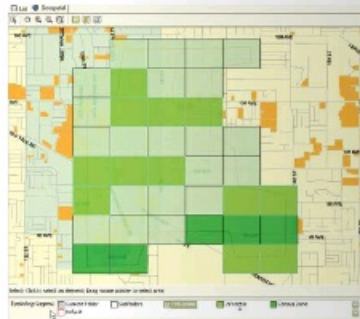


Figure 3: Documents from different projects can be navigated spatially and colour-coded for easy identification

Users can employ digital rights technology. Managing access and modifying rights to content using digital signature technology enables author verification and seals changes. These technologies bring the 'sign and seal discipline' to the digital age and strengthen an organisation's change management capabilities.

Integration and interoperability

This geospatial server technology is highly extensible, allowing customisation at any level of the architecture. It can be integrated

in a service-oriented architecture with a loose coupling of applications in order to support higher-level, organisation-wide workflows. In national defence organisations, critical missions interact with multiple operational systems like operations (OPS), intelligence (INT) systems, administration (Adm-Pers), and terrain (TRN), which are individually created and maintained. The terrain systems refer to the spatial systems that form the backbone of all other systems. This geospatial server technology provides the required flexibility to integrate with these systems, enabling tight integration and collaboration among all operational subsystems. This holistic approach to the problem assists decision makers in becoming more effective in executing their duties in a timely fashion. It also provides highly accurate, interoperable tools to exchange information from a wide range of systems and data.

Simultaneous access to one set of data

There are many occasions in which many people have to work on the same file without adding redundancy to the data. For example, in defence operations, people in the field may have to work on one file with different areas of interest to update various strategic positions. Hence, it is vital to have these capabilities in a geospatially enabled tool. The technology being discussed here works with the standard Oracle Workspace Manager to enable multi-user editing workflows. It provides for versioning and long transactions with pessimistic locking or optimistic locking. There are reconciliation tools to help users

reconcile versions by providing tools to identify, browse, visualise, and resolve conflicts and commit the reconciled version.

Smart distributed plotting and publishing

This geospatial server technology can also provide publishing and plotting, supporting the creation of accurate and intelligent output in a centralised way. A hardcopy or intelligent PDF can be produced using any of the content available. Bookmark and redlining tools can also be leveraged in a simple browser to document comments or changes.

Geospatial-based technology that is able to effectively serve the needs of a national defence organisation must be able to provide data integrity, the quick retrieval of information, workflow and process management, effective collaboration, and interoperability, and be open and scalable. Bentley's geospatial server-based technology can provide contextually intelligent and immediate access to all information critical to defence organisations. It assists in making intuitive and instantaneous decisions that may appear problematic, complex and time consuming. Considering all the critical documentation needed to evaluate and respond to a situation, reducing the time to retrieve this information can greatly impact the success of any national defence-related operation.

Such an operation requires information or data that is largely created and managed by many different coordinating agencies and contracting firms. In many cases it will include maps of the area, the hydrology and

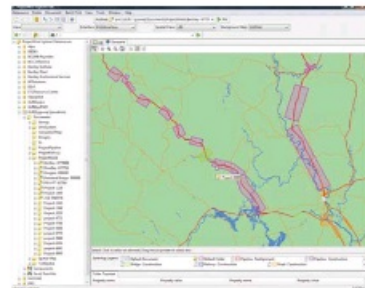


Figure 4: The linear referencing and indexing of features and files along a linear feature in the background map make it easy to find files attached to a linear location

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engineering of the related water systems, structural drawings of tunnels, schematics of the electrical systems, designs of tributary and surrounding highway systems, and much more. By using the functional capabilities of the server technology, the goals of defence operations can be accomplished more quickly and accurately.

Rapid access to information is a critical requirement for emergency response. Access to the right information at the right time can streamline interrelated processes, save time, and considerably increase the efficiency of all participants. Hence, this technology, with its extremely intuitive tools, will help national defence strategists analyse information holistically and arrive at quick decisions with fewer errors.



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